Optimising Water Framework Directive River Basin Management Planning Using an Ecosystem Services Approach

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EXECUTIVE SUMMARY

This project was undertaken for the Scottish Environment Protection Agency (SEPA), via a request to the CREW call down service as part of a range of SEPA initiatives under their Embedding Ecosystem Services work stream. The objective of this report is to review the process of River Basin Management Planning (RBMP) and identify how and where an Ecosystem Services Approach (ESA) might assist SEPA in improving their delivery of the Water Framework Directive (WFD). The report describes a practical methodology to implement an ESA at the catchment scale to meet the requirements of the WFD and other water-related policies, while maximizing the potential delivery of multiple benefits. In doing so, we try to link the philosophy and tools of ESA to the specific policy implementation process of WFD, in a manner not done so far elsewhere.

Reports in the literature have been reviewed to identify the key ecosystem services relevant to RBMP and where an ESA could add value to RBMP as shown in the diagram below:

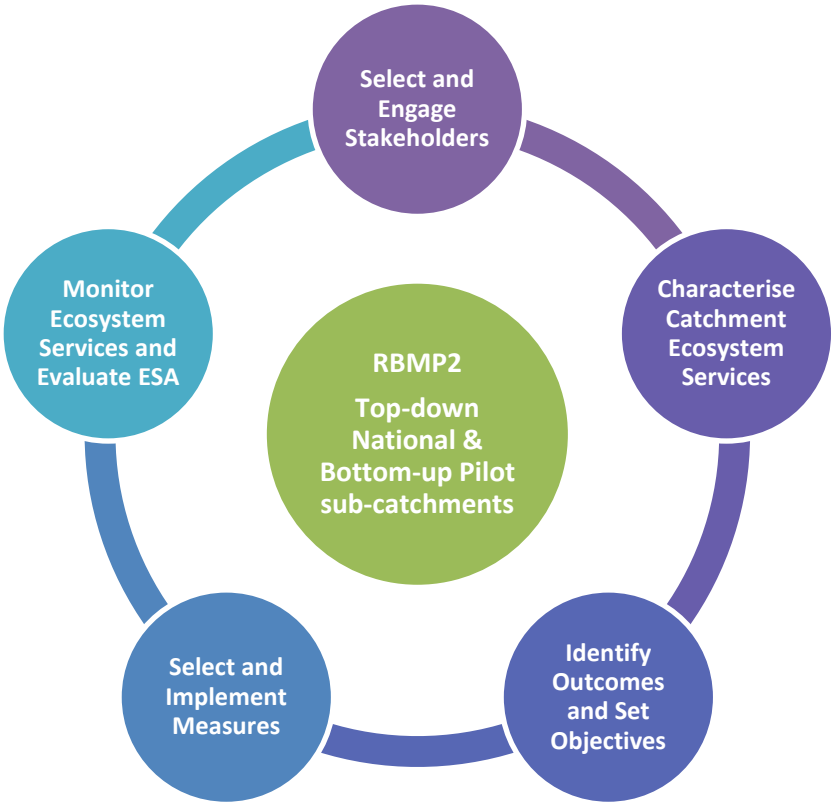

Figure 1: Five Stages where an ESA can add value to RBMP

A series of recommendations have been developed, including identifying whether they should be implemented during the RBMP2 (current) cycle or in the next RBMP3 cycle, and if they should be rolled out nationally or piloted first. A workshop helped to refine the recommendations on how best to use an ESA to implement river basin management planning and catchment management. The workshop was attended by SEPA, SNH and Scottish Government staff from a range of disciplines and roles within delivery of RBMP, so as to gain their perspective on operational challenges to its implementation.

Key Recommendations:

General:

- SEPA should take a nested approach that combines national 'top down' development with a series of 'bottom up' pilots in which an ESA can be trialled at a sub-catchment level in RBMP2, for potential roll out further in RBMP3.

Selecting and engaging with Stakeholders:

- Scale of engagement is critical and should be focussed at the sub-catchment and water body level. This best reflects the functional scale at which ecosystem processes operate and the management and decision-making scales of key stakeholders and local communities (pilot in RBMP2)

- In-depth stakeholder engagement, whilst potentially productive is time consuming and resource heavy; its effectiveness should be explored through pilot studies in RBMP2.

- New web-based means of communication should be developed both for engagement of local communities in the pilots and for wider consultation on ecosystem services and feedback on developing plans nationally (RBMP2)

- SEPA should map potential stakeholders against ecosystem services ensuring representation of all services and relevant stakeholders is achieved (RBMP2 for both national and pilots)

Characterising catchment ecosystem services:

- Catchment characterisation should initially be done from a top-down perspective, using existing data as indicators to map ecosystem service provision (RBMP2; national and pilot)

- Use should be made of a standard set of ecosystem services, developed and shared with partners (RBMP2; national and pilot)

- The choice of mapping technique and the algorithms to be used for measuring service provision are important, and must be based on robust science and transparent processes for creation of measurements (Develop with partners; RBMP2 for full implementation RBMP3)

- Local communities should assist in identifying service provision as they see it in their own language and experience. (pilot RBMP2)

Identifying outcomes and setting objectives:

- Setting objectives requires the production of opportunity maps to analyse locations where opportunities exist to deliver multiple ecosystem service benefits alongside and as part of RBMP (Pilot RBMP2; roll out selected sub-catchments RBMP3)

- Locations of potential conflicts can also be assessed through partnership working in the pilots at the community scale, bringing local knowledge to bear on RBMP priorities (Pilot RBMP2). The use of non-quantified and non-monetary values is recommended for prioritisation and trade-offs between complementary and conflicting services for water body improvement (Pilot RBMP2; roll out selected sub-catchments RBMP3).

Selecting and implementing measures most suitable to achieve outcomes/objectives:

- Selection of measures can be achieved through comparing scores for different options against changes that might be expected in ecosystem service provision (Pilot RBMP2; roll out selected sub-catchments RBMP3)

- In choosing the most cost effective measure to deliver good ecological status, if the costs to wider ecosystem services delivery are 'disproportionate', the objectives may need revisiting (pilot RBMP2; rollout selected sub-catchments RBMP3).

Monitoring and evaluation:

- Monitoring requires coverage of changes in ecosystem service provision with improved ecological status and evaluation of the process of ESA implementation (Start monitoring nationally RBMP2; evaluation for RBMP2 pilots).

- Feedback from stakeholders will be essential in assessing the costs and benefits of an ESA compared to business as usual (Evaluation from RBMP2 pilots).

1 INTRODUCTION

This project was undertaken for the Scottish Environment Protection Agency (SEPA), via the CREW call down service to complement a range of initiatives under SEPA's Embedding Ecosystem Services (SEES) work stream. The project was managed by the James Hutton Institute, and is linked to their work under the Scottish Government Strategic Research Programme.

The main objectives of the project were agreed as:

'to develop and describe a practical methodology/decision making framework to implement an ecosystem services approach at the catchment scale to meet requirements of the Water Framework Directive (WFD) and other water-related policies, while maximising the delivery of multiple benefits. The identified approach and methodologies should be focussed on participation, should be risk-based (i.e. prioritise action to address pressures that cause most damage to ecosystem services), and functional within the WFD River Basin Management Plan (RBMP) process'.

In reviewing work on the first round of river basin management plans, and in consultation on future direction, SEPA set out a commitment to working more effectively at the catchment scale, and to exploring how improvements to the water environment could benefit a wide range of people and interests. This included considering how to incorporate this into their decision-making processes, and investigating the potential for an ecosystem services approach as a means to help deliver these objectives. It is recognised that applying an ecosystem services approach should add value to river basin management planning in the following ways.

- Improved transparency of the decision-making process:
    - Greater involvement of stakeholders; and
    - Greater trust in, ownership and resilience of the process and decisions made.

- Consideration of a wider range of ecosystem services and multiple benefits in the decision-making process:

    - New sources of information and expertise brought to bear on the process;
    - Better local knowledge of cross-sectorial opportunities, and cultural constraints;
    - Clearer identification of who provides, who benefits from and to whom different ecosystem services matter;
    - Development of a decision-making tool;
    - Development of an accepted and robust methodology for comparing benefits and trade-offs for objectives and measures in relation to ecosystem services; and
    - Better prioritisation enabling access to funding mechanisms for implementing RBMP.

The study comprised a combination of literature searches, review, and synthesis and draft reports produced by Dundee University. Project team meetings allowed for feedback, guidance and direction from SEPA staff and the James Hutton Institute project manager. A workshop was held in May with key staff from SEPA, along with representatives from Scottish Government and Scottish Natural Heritage to help refine recommendations. The opportunity was also taken to meet with staff at the Environment Agency, who were producing a Framework Guidance document for the EA on

ecosystem services assessment, as well as SEPA staff also working on using an ESA for their regulatory approach.

This report sets out the origin of an Ecosystem Service Approach (ESA), before outlining the advantages and challenges of an ESA for environmental decision making. The report details the application of an ESA to River Basin Management Planning (RBMP), focussing on five areas within the RBMP cycle, with insights drawn from existing case studies leading to recommendations for SEPA. We end with some general issues for SEPA to consider.

2 INTRODUCING THE ECOSYSTEM SERVICES APPROACH

2.1 What is an Ecosystem Services Approach?

An Ecosystem Services Approach is an extension of the Ecosystem Approach, elements of which can be traced back many decades (Costanza & Daly 1987). The Ecosystem Approach itself owes its formal origins to the Convention on Biological Diversity, within which it is defined as a ***"strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way"***.

The 12 principles of an Ecosystem Approach (as agreed in 2000) are:

- Principle 1: The objectives of management of land, water and living resources are a matter of societal choices
- Principle 2: Management should be decentralised to the lowest appropriate level
- Principle 3: Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems
- Principle 4: Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:
  Reduce those market distortions that adversely affect biological diversity;
  Align incentives to promote biodiversity conservation and sustainable use;
  Internalise costs and benefits in the given ecosystem to the extent feasible.
- Principle 5: Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach.
- Principle 6: Ecosystems must be managed within the limits of their functioning.
- Principle 7: The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.
- Principle 8: Recognising the varying temporal scales and lag-effects that characterise ecosystem processes, objectives for ecosystem management should be set for the long term.
- Principle 9: Management must recognise that change is inevitable.
- Principle 10: The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.
- Principle 11: The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
- Principle 12: The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

It is noted that only Principle 5 actually refers to *services derived from ecosystems*, in terms of the importance of conserving structure and functioning.

Government organisations have since reduced this list to three-five key principles. The Scottish Government (http://www.scotland.gov.uk/Resource/Doc/345453/0114927.pdf) have usefully distilled the principles down to:

- Consider natural systems;
- Take account of the services that ecosystems provide; and
- Involve people

Within the context of freshwater management, an ecosystem approach has been considered by IUCN and WWF (1998) to mean:

"*assessing water availability (quantity and quality), identifying inter-relationships at the ecosystem level, predicting the environmental and social impact of any proposed action and evaluating the consequences before any decision is made on use. An ecosystem approach to freshwater management emphasises the dependence of maximising the sustainable use on the conservation of freshwater ecosystems and focuses on catchments or groundwater systems as the appropriate units of management*."

Whilst this is a useful definition, there is not, as yet, a similarly well-established definition of an Ecosystem *Services* Approach. SEPA advise that "*an ecosystem services approach involves:*

- *Identification of ecosystem services of relevance to the environmental change being considered;*
- *Description of the state of the ecosystem services;*
- *Identification of the change in provision of ecosystem services resulting from the environmental change being considered; and*
- *Selecting a course of action of take based on the option with least adverse and most positive impacts on ecosystem service provision.*

It is not considered separate from an ecosystems approach; rather it is part of an ecosystems approach and a method for use in practice to achieve the outcomes of an ecosystems approach".

An Ecosystem Services Approach focuses on the delivery of four types of service. The development of the approach owes much to the production of the Millennium Assessment (MA) in 2005. This focuses on how healthy functioning ecosystems provide humans with a range of goods and services that, together with further inputs of capital and knowledge, produce 'human well-being'. It stresses the inseparability of those who depend on the environment (for food, recreation, culture, etc.) with the physical state of the ecosystems and processes that underpin it. However, this simple definition hides confusion as to terminology, and underplays the uncertainty as to measurements of services and the form of the linkages between land/water management and delivery of services.

The MA identifies four categories of ecosystem service:

-Supporting - e.g. soil formation, pollination, photosynthesis, biodiversity itself;
-Provisioning - e.g. water supply, food production; timber;
-Regulating - e.g. climate control; natural flood management, water quality;
-Cultural - e.g. recreation, tourism, spiritual values.

SEPA is considering which of the ecosystem services associated with the water environment it should take account of within its regulatory roles, and for its economic characterisation of the water environment for the second RBMP. This work is on-going, and looks to identify and map provision by the water environment of some 20-30 ecosystem services at the scale of individual water bodies, whilst recognising that access to reliable information varies greatly between services. This project has tried to complement this process where possible (e.g. see page 24 on characterising catchment ecosystem services). It should be stressed that this is the first time that an attempt has been made to apply an ESA in practice to a policy. This is very much work in progress and not a final solution.

2.2 What does an Ecosystem Services Approach do for environmental decision making?

The 'added value' of adopting an Ecosystem *Services* Approach is the provision of a framework for conceptualising the link between the environment and the ways in which people value and 'use' it – the four categories of ecosystem services. The report focusses on what extra an ESA might offer RBMP2 which looks to move beyond the initial processes adopted for RBMP1. As such, it can help identify the variety and value of ecosystems at a given scale (e.g. a catchment or individual water body), and assist in analysing trade-offs between potential decisions on land and water management. In doing so, the ESA also identifies those stakeholders who will be most impacted by such decisions and thus who should be included within the decision-making process.

Synthesis of the wide range of literature and case studies reviewed (annex 1) suggests an ESA approach might include the following steps;

- identify issue,
- characterise system (define study area, context, analyse ecosystem functions, identify ecosystem goods and services, analyse contribution of ecosystem services to human well-being, understand past change and trends),
- develop policy and management options,
- use scenarios and appraisal of options,
- make a decision based on appraisal,
- monitor and evaluate impacts.

The TEEB report (2010) characterises this in three stages: identification of human activities on ecosystems; their quantification (not solely in monetary terms); and integration of results into management decisions.

2.3 Advantages

As a framework for decision-making, the process focuses on transparency, inclusivity and active participation of different stakeholders in reaching a common vision and understanding. It also focuses attention on the benefits (and dis-benefits) that different groups will experience as a result of decisions made. Key areas most relevant to SEPA's potential use of the approach would include advantages in terms of:

- **The overall decision-making framework -** ESA can provide a conceptually coherent framework within which to address the achievement of multiple benefits from integrated catchment management;

- **Stakeholder engagement** - ESA can help identify the 'actors' involved, the scope and methods of engagement, the information to be provided and received, issues faced and success developed through shared development and ownership of a common vision;

- **Ecosystem services and benefits considered** - the use of a standard and broadly comparable set of services to be addressed and modified, as necessary to take account of location, issues, data availability, scale and temporal factors;

- **Assessment of ecosystem service provision -** ESA can provide a framework to assimilate and integrate data (e.g. GIS mapping). It can assist in defining the biophysical area under investigation, characterising ecosystem service provision and deal with dynamics (such as limits and thresholds);

- **Valuing ecosystem services** - valuation can help clarify synergies and conflicts in people's views of ecosystem services. However, heterogeneity was observed in the extent to which ESA studies address valuation. It can assist showing overall costs and benefits, but in practice many projects did not undertake valuations, but used other biophysical, economic or social indicators to measure ecosystem services;

- **Exploring trade-offs and prioritising ecosystem services** - prioritisation is an essential process in decision-making and an ESA can help in defining objectives and approaches, and in understanding the effects of land/water management change on the delivery of services;

- **Sources of data** - the existing SEPA data collected at both water body and river basin district level provide a good starting point for ESA. Enhanced stakeholder engagement will reveal new information and knowledge which, along with other sources of data can be integrated in to an ESA. Data on certain ecosystem services, especially cultural issues which may have previously been undervalued, will become more visible;

- **Validating results** - an ESA could provide a methodology for validation of results, using stakeholder input, as well as other metrics.

Projects reviewed that specifically look at the linkages of ESA with the WFD (see for example ESAWADI and ONEMA case studies) identify the following key potential contributions:

- ESA can link practice between different policies, including WFD, Marine, Floods, etc., and bring issues and values from a range of disciplines into a single framework;

- ESA can provide a consistent tool to reinforce knowledge on the relationship between Good Ecological Status (GES), ecosystems and society. It can structure scientific knowledge around these issues, and generate local knowledge through public participation;

- ESA can help policy-making by 1) optimising policy design, using ESA to define different management scenarios, 2) ensuring policy choices produce more benefits than they cost (through cost benefit analysis), and 3) convincing affected parties of the relevance of policy during implementation;

- ESA can help raise awareness of the role of the river basin scale for society and the environment, and improve communication on the benefits for society of achieving Good Ecological Status (GES). It encourages individuals to consider issues previously overlooked and can create a common language for policy-makers, business and society that could enable the real value of natural capital and flow of services it provides to become visible;

- ESA can play a role in better relating ecological functionalities with economic and social dimensions; for example by better elucidating social values and interests related to water uses. In doing so, ESA can reveal opportunities to work with nature by demonstrating where it offers cost effective means of providing valuable benefits;

- ESA could support new or improved policy instruments, such as payments for ecosystem services (PES).

2.4 Challenges

ESA is not a silver bullet and there are many challenges associated with its implementation (see for example Cook & Spray 2012 for a review of these in relation to integrated water resource management). The following seem most relevant to SEPA's potential use of the approach in RBMP.

Language - 'ecosystem services' means nothing to most people, and the terminology is off-putting. Phrases such as multiple benefits or the benefits we receive from nature may be better. The concept is not well expressed in everyday terms and implicitly focuses on environmental issues, as opposed to economic growth or societal demands.

Complexity - bringing a new range of activities and options to the table makes decision-making more complex. It involves more stakeholders, more time, more information, more inter-relationships between options and, potentially greater uncertainty in the outcomes.

Measurement - in most instances, the actual level of ecosystem service provision (such as flood risk regulation) can only be represented by proxy indicator values or the presence/absence of certain associated features. Data for many services, especially cultural ones are lacking.

Valuation - cost benefit analysis and trade-offs require valuation and not just in monetary terms. Whilst not a challenge unique to ESA, factors such as the intrinsic nature of services or intergenerational equity may be particularly hard to value. ESA may assist by making these issues more visible.

Data availability – access to relevant data sources at the appropriate scale is a common problem, as is sharing information between organisations.

Scientific uncertainty - a particular challenge is the uncertainty of the link between function, service and benefit. This covers such areas as the different services, the link between land/water management and delivery, and between changing pressures and responses.

Integration – SEPA is bound within operational and resource needs, and within a legal and policy context set by the WFD. An ESA cannot sit outside this framing.

Raising expectations – involving local communities more and using scenarios of potential futures will raise expectations. As well as risking stakeholder fatigue in the engagement process, these expectations may not be realised, potentially leading to alienation and disengagement.

More specifically, within river basin and catchment management, we also recognised a number of challenges and risks for the success of ESA, including:

- Ecosystem services may be promoted independently of the whole ecosystem for the purposes of justifying selective policies and land use choices;
- ESA could lead to a focus on barriers rather than opportunities;
- ESA may be perceived as another strict framework implemented from above or another toolkit to apply without additional support, training, finance or staff resources;
- There are still many questions as to how ESA can be translated into practice, in particular given the few attempts at using it for catchment management and the WFD.

3 MAPPING AN ECOSYSTEM SERVICES APPROACH ONTO RBMP

The objective of the Water Framework Directive - to achieve 'good ecological status' (GES), provides a link between the process of river basin management planning and healthy functioning ecosystems. Although the concept of ecosystem services does not appear as such in the WFD, an ESA is compatible and applicable to RBMP. Furthermore, as the ONEMA report identifies, an ESA may provide a number of opportunities for WFD economic characterisation. The report highlights a number of articles within the WFD which refer to valuing ecosystems, including: Article 4 - decisions on derogation based on disproportionate cost; and Article 11 – selection of the most cost-effective measures for achieving 'good ecological status/potential' for the programme of measures.

Article 4 of the WFD directs member states to take account of the full range of costs and benefits, not just financial ones in making decisions on programmes of measures. The use of an ESA will assist the identification of these opportunities. For example, no breach of the WFD occurs where "*failure to prevent deterioration from high status to good status of a body of surface water is the result of new sustainable human development activities*"; or where "*overriding public interest and/or the benefits to the environment and to society of achieving the objectives …..are outweighed by the benefits of the new modifications or alterations to human health, to the maintenance of human safety or to sustainable development*" or that "*the beneficial objectives served by those modifications …. cannot for reasons of technical feasibility or disproportionate cost be achieved by other means, which are a significantly better environmental option*". Article 11 then refers to programme of measures needing to include "basic" measures and, where necessary, "supplementary" measures, including not only economic instruments, but negotiated environmental agreements, codes of good practice, recreation and restoration of wetlands areas; educational and demonstration projects; demand management measures, efficiency and reuse measures.

The basic RBMP cycle cannot be changed, so the inclusion of ESA within WFD is set by the constraints and requirements of the RBMP process (Annex 3). It needs to fit with what SEPA and its partners are able to deliver. In this sense, the introduction of an ESA is about integration and what else SEPA could or should do in addition to what is already happening. It must be stressed that the current process of RBMP already 'ticks' many of the boxes of an Ecosystem Services Approach.

In reviewing the RBMP process, we have identified five steps where the introduction of an ESA could add significant value to the current RBMP and associated catchment policies and practices:

- selecting and engaging with stakeholders;
- characterising catchment ecosystem services;
- identifying outcomes and setting objectives;
- selecting and implementing measures most suitable to achieve objectives; and
- monitoring and evaluation

Whilst selecting and engaging with stakeholders is not a step in its own right within RBMP, it is fundamental to the nature of the outputs and outcomes, and a key element of the ESA. Therefore this report adds the additional step of 'selecting and engaging with stakeholders'. Involving people in prioritising actions and measures will enable them to take greater ownership of these decisions. It will also promote RBMP as Scotland's plan to improve the nations' waters, rather than something imposed on communities from above. In fact, the elements feed in to each other, with stakeholder engagement underpinning the identification of ecosystem services (ES) in catchment characterisation, objective setting, selection of measures and, finally in evaluation and monitoring.

Figure 2: Five Stages where an ESA can add value to RBMP

Our literature review showed that there is far more information available for the first three steps described than for the last two. However, it is the practical application of measures on the ground at which the concept of ecosystem services becomes meaningful to many stakeholders. It is also the

choice of where and when to fund measures, partly when aligned with existing funding mechanisms, that could be particularly contentious.

The process is tightly constrained; indeed the first stage has already been completed without specific integration of an ESA. However, the iterative process, especially the production of the Challenges for the Future Report provides an opportunity to feed into the RBMP cycle from now on. What it does highlight is that the five steps would need to be largely completed by the end of December 2013, when formal public consultation starts ahead of the 22nd June 2014 deadline.

The objective of this report is to highlight how these five stages of an ESA might help SEPA identify the key ecosystem services relevant to RBMP; undertake trade-off analysis in an open, transparent and robust manner; leading to a balanced decision making process about where measures should/should not go and when they should be implemented, taking into account ecosystem services and stakeholders' views.

This places a focus on identifying the multiple benefits arising from delivery of RBMP within a framework that looks to optimise WFD and ecosystem service delivery together. It would more fully describe and thus improve the estimates (monetary and/or otherwise) derived from agreed objectives and, in doing so add a new dimension to economic characterisation.

Hence the process of objective setting would not look at the attainment of WFD good ecological status in isolation, as the only outcome, but take other benefits, and potential dis-benefits, in to account. Where an RBMP objective might be seen to have a major adverse impact on other ecosystem services, this could be used in assessing whether it is justified to set an alternative, lower standard of objective, or the designation of an Heavily Modified Water Body is re-assessed.

This report takes each of these steps in turn and illustrates:

- how it relates to the WFD cycle and was undertaken in the first round of RBMP;
- what moving to an ESA might add and involve, using evidence from the case studies; and
- recommendations for implementation.

Recommendations were framed in three potential options that represented increasing levels of engagement - from very limited, through a partial to a full ESA. However, the full ESA option would go beyond SEPA's water and wetland responsibilities, and would need coordinated delivery by other partners. It raised issues that lie outside the scope of RBMP, making it difficult to deliver within the timetable of WFD, which was one of the evaluation criteria.

Instead, a single recommended approach is provided which indicates how to apply an ESA within the timetable and delivery requirements of RBMP. It recognises that SEPA's interests must be focused around management of water within the catchment. To date, RBMP has operated at a number of scales - from River Basin District down to individual water bodies. The report introduces an additional scale of 'catchment', bringing together water bodies as small functional sub-catchments. It identifies steps to be incorporated at this local level – i.e. how to apply ESA at a local scale to prioritise and implement measures, as well as at the strategic national level. In part, this follows the approach taken in RBMP1 where the requirement to tackle specific areas of serious diffuse pollution was met through working in an integrated manner in local priority catchments.

3.1 Selecting and engaging with Stakeholders

3.1.1 Link with WFD cycle and implementation in 1st RBMP

Engaging with the relevant stakeholders is fundamental to an ESA. Stakeholders are the providers, protectors and users of the ecosystem services under consideration, and it is their valuation of these for human well-being that underpins the ESA concept. In terms of the WFD, it is related to Article 14, covering public information and consultation, which stipulates "*Member States shall encourage the active involvement of all interested parties in the implementation of this Directive, in particular in the production, review and updating of the river basin management plans*". This is further recognised in the Water Environment and Water Services (Scotland) Act 2003, where it states that "*The Scottish Ministers and every public body and office-holder must, in exercising any functions so far as affecting a river basin district, have regard to… the river basin management plan for that district*…."

There is an expansive literature on stakeholder typology and analysis (e.g. Reed *et al* 2009). Whilst many methods are recognised, there is no agreed method for selecting stakeholders to groupings such as RBMP advisory groups, though organisations such as responsible authorities in relevant legislation form a starting point. Scale and scope are also vital, defining the number of stakeholders that can be accommodated, and their interests. Thus the scope of the National RBD Group was focussed on strategic issues, whereas the AAGs focussed on regional implementation issues though arguably, still at too strategic a sub-basin level to get a site-specific understanding of local issues.

3.1.2 What moving to an ESA might add and involve

Public participation through an ESA can be used to inform assessments of ecosystem service provision; to examine why and to whom services matter; and to draw on local and strategic knowledge. It can educate and influence those who need to have ownership of the RBMP through shared decision-making. In a systematic manner, it has been used to assist defining the issues for individual study areas; to develop and evaluate scenarios (choices and trade-offs); and to inform policy and land management decisions. There is a need to assess the level of engagement required, before attempting to redesign the existing RBMP stakeholder participatory process. Categorisation of potential stakeholders will identify those who are relevant, and whose involvement will add value to the RBMP process and delivery of ecosystem services. Power, competency and impact are criteria for selection of representative stakeholders who can influence and inform the ESA and RBMP.

Scale of engagement is key. At the national level, stakeholder involvement can inform questions such as which ecosystem services of national importance to include in RBMP, or the prioritisation of resources between issues and between catchments for action (e.g. the 14 diffuse pollution target areas). At the sub-catchment scale, it can aid prioritisation by adding information on local importance of specific ecosystem services, and help identify opportunities for added value and multiple benefits. At the scale of individual pressures and water bodies, engagement can bring together local stakeholders around jointly agreed programmes of measures (POMs) to tackle agreed targets for improvement of the environment for multiple ecosystem services. It brings new information to the debate, while highlighting data gaps and potential conflicts. Uptake by local 'champions' can greatly improve implementation through peer-to-peer learning.

Working with existing groups and partnerships saves time and effort in establishing new partnerships. A challenge for SEPA may be to include new actors, such as Community Councils in existing structures at the local scale. The choice of techniques should be guided by the scale required for engagement and by the scope, outputs and timings required for RBMP. The requirements at the strategic RBD level differ from those at the water body level. Resource-intense methods such as focus groups can only be considered at a local level, whereas questionnaires are more amenable to wider engagement. The scope and level of participation will also vary at different stages of RBMP, such as characterisation of ecosystem services or prioritisation of measures.

Engagement means working together to understand the issues that stakeholders see as important and how, within this, ecosystem services are to be considered; gaining a common understanding of the catchment and water bodies through reviewing information and mapping; developing and appraising options to maximise opportunities for multiple benefit delivery and minimise conflicts; and agreeing how measures are to be delivered. A challenge is where local stakeholders are asked to contribute; steering organisations should be aware that a project could move on a different trajectory than initially planned.

3.1.3 Recommendations for selecting stakeholders

Within RBMP1, SEPA created a stakeholder engagement process and strategy that does not need to be dismantled, rather reviewed to ensure stakeholders representing wider ecosystem services are involved and focussed at the appropriate scale. This will ensure full coverage of relevant ecosystem services, and those impacted by changes to them, particularly at a local scale. This should lead to a greater emphasis on hitherto undervalued and unmeasured benefits, such as cultural services.

Recommendation 1 - Review RBMP1 engagement in terms of inclusivity, alignment and scale. **(SEPA to do in-house, now, some additional RBMP staff time required) – NAG and AAG**

This should focus on ***Ecosystem Service groupings.*** As ecosystem services are the key deliverable, stakeholders should be grouped in terms of the services provided by ecosystems, such as 'provisioning' stakeholders (e.g. farming) or cultural stakeholders (tourism) and aligned to SEPA's list of ecosystem services. This should identify the primary ecosystem service providers and beneficiaries.

At the strategic RBD scale, this involves checking the alignment of existing members of NAG to identified services, such as NFU(S) to represent agricultural provisioning services. It raises issues as to who and how to capture some of the other services, such as cultural ones in a meaningful manner. Tourist Boards, Historic Scotland, etc. are potential participants. At the sub-catchment and water body scale, this cultural role could be taken by Local Community Councils or sub-groups of Community Planning Partnerships who may represent some intangible cultural values of local communities.

Recommendation 2 - Assess which stakeholders have the power to influence and direct resources and decision-making around ecosystem service delivery**. (SEPA to do in-house, now, some additional RBMP staff time required) NAG and AAG.**

This recommendation can be undertaken with a simple interest-influence matrix as a check by SEPA on existing participants. At the NAG and AAG level, for most services, this will reflect the organisations already present, including those with regulatory powers (such as development control through Local Authorities), resource power (such as Scottish Water), and influencing power (including NGOS, media). Following the example from Reed et al (2009), an assessment of power relations relating to water quality might look like:

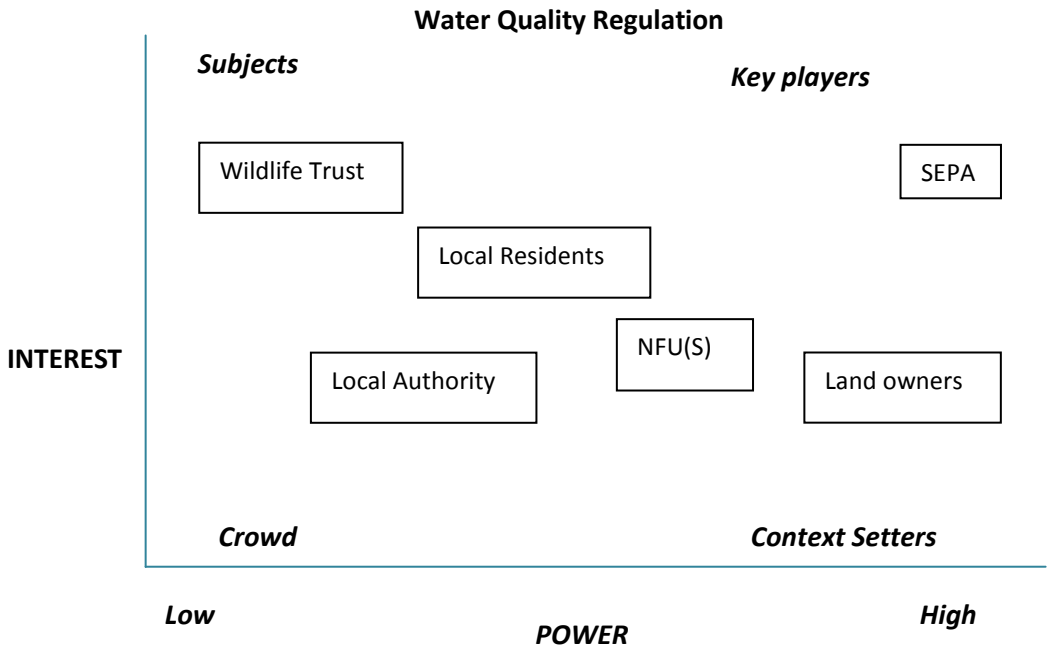

Figure 3. Diagram of stakeholder organisations' hypothetical interest in and power to influence the status of water quality within a sub-catchment

Of particular importance is the identification of 'champions' whose engagement and actions will influence the thinking of others nationally and within local communities. In many instances these will be influential local land managers, recognised as being leaders of economic and social change, particularly around land management practices and environmental issues.

***Recommendation 3 - Identify those stakeholders who currently benefit from ecosystem service provision and who will be potentially impacted by changes to service provision at the local scale as a result of the introduction of POMS*. (SEPA to do in-house, now, some additional RBMP staff time required) Pilot sub-catchments.**

This is relevant at the sub-catchment and water body level, and will only be necessary where POMs are being actively discussed. It should take the form of a simple check to show those affecting and affected by, the issues. It can be scored on a scale as to the extent to which that occurs (high/medium/low). In the water quality example above, farmers would have a high impact and affect ecosystem services for water quality regulation through diffuse pollution, while wildlife organisations have low impact and a negative beneficiary of these actions. As providers and

beneficiaries will mainly be situated within the same catchment, key players will include individual large land owners/managers, major industries and local Community Councils.

3.1.4 Recommendations for engaging stakeholders

Having identified the stakeholders to be involved, scale is the big issue for stakeholder engagement, given that SEPA is constrained by the scope of services under consideration, the agenda and timetable for engagement, and the outputs required by RBMP. ***The process we recommend is a nested one using a range of engagement techniques to promote and contrast top-down and bottom-up engagement at different scales.***

Recommendation 4 – Set up a limited number of sub-catchment pilots (e.g. 4) **(SEPA to do in-house, now, RBMP staff to recommend to RBMP implementation Board, some additional RBMP staff time required)**

These should focus on a selection of degraded, failing water bodies, use existing 'pilot areas' (e.g. Forth/Clyde Valley, Scottish Government priority restoration catchments, etc.) and build on existing engagement tools ('Love your river' campaign, SEWeb interactive mapping, etc.). In each, the aim will be to trial this more interactive stakeholder approach, with a focused outreach engagement campaign, and to compare this with the results of the existing processes in other sub-catchments

Recommendation 5- Focus engagement at the sub-catchment pilots **(SEPA to do in collaboration with expert facilitator/consultants, now, +£50,000 project[1])**

Currently SEPA work at the national and regional scale through programmed NAG and AAG meetings, timed to meet the staged requirements of the RBMP process. Continuing that formal stakeholder engagement will be necessary, but new resources will be needed for the detailed pilot engagement, including arranging workshops, materials, venues, facilitators and maintaining contact and providing feedback. This should include structured questionnaires, semi-structured interviews and, where necessary focus groups to deliberate on key issues. Together these would provide SEPA with a comprehensive understanding of ecosystem services as seen by those recipients in terms of human well-being. It will involve the recruitment of stakeholders, the set up a series of sub-catchment or water body scale facilitated workshops (max 3), using deliberative techniques, such as undertaken in the Carse of Stirling Ecosystem study. It should extend to other communication channels, to engage new audiences and services, using web-based tools for gauging reactions and priorities across the sub-catchment. These can assist in maintaining stakeholder involvement and in encouraging joint assessment of issues, with participants developing ecosystem service themes in ways relevant to their own well-being and needs.

Recommendation 6 - Extend the use of new engagement tools and novel web-based communication channels. **(SEPA IT to do in-house, now, resource unclear as dependent on how much funded through the SEWeb project) National RBD scale.**

This should include using SEWeb to gather information on what wider stakeholders see as important services nationally and locally, and to enhance consultation on ecosystem services.

[1] Rule of thumb estimates, not based on any in-depth costings but to provide a sense of the relative cost of each recommendation.

3.2 Characterising Catchment Ecosystem Services

3.2.1 Link with WFD cycle and implementation in 1st RBMP

This step relates to the characterisation of the River basin districts or catchments, which includes: pressures and impacts analysis, the economic analysis, and the delineation of water bodies.

The first cycle of Scottish RBMP used the Significant Water Management Issues report to identify key pressures on the water bodies that were impacting on their ability to reach Good Ecological Status or alternative objectives. Pressures were seen as being due to:

- Diffuse pollution (from rural and urban sources);
- Point source pollution;
- Abstraction and flow regulation;
- Impacts on morphology; and
- Invasive alien species.

These pressures were allocated to sectors thought to be the main source of these pressures, which helped shape the stakeholders involved, how the objectives were assessed, targets chosen and the measures required. RMBP1 was delivered at three levels – national, Area Advisory Group and at the scale of the individual water body, with implementation at the water body scale. For implementation, the second round of RBMP is likely to focus on the intermediate scale of the sub-catchment, representing a biophysical entity that, in general the AAGs were not able to cover, with the exception of certain 'bundles' of water bodies, such as diffuse pollution priority catchments.

3.2.2 What moving to an ESA might add and involve

Using an ESA for the 2nd cycle will:

- Shift the focus away from purely WFD-defined environmental problems, towards the rationale for why we want to improve our catchments and to prevent deterioration in healthy rivers, lochs and coastlines;
- Help consider the pressures that impact on the water bodies, and the services provided by water bodies having good ecological functions;
- Enable consideration of a wider range of services, providing a holistic perspective for water body and catchment management, and illustrate where multiple benefits can be achieved, or where conflicting perceptions and community values may raise concerns; and
- Mean implementation at the catchment, sub-catchment and water body scale.

Four main areas are seen as being relevant in the characterisation of catchment ecosystem services:

Defining the catchment or biophysical area under investigation: The challenge is to plan and manage at a geographical scale at which ecosystem services operate, and which is also meaningful to stakeholders. Many ecosystem services are delivered through bio-physical processes operating within a catchment (sediment transfer, flood mitigation, water quality enhancement). Thus a place-based approach that maps services as bundles across units that have strong social relevance is the most applicable approach. It meets the need to carry out catchment assessment given upstream-downstream linkages and the ecosystem functions specific to the catchment scale. Considering river

basins as one ecosystem may not always be appropriate when attempting to conserve or enhance individual functions unique to subsystems, so sub-catchments and water bodies are still important.

Choice of Ecosystem Services: The Millennium Ecosystem Assessment, TEEB (2010) and the UK NEA (2011) are the starting points in most projects for identifying ecosystem services, providing a broadly inter-comparable set of services across bioregions and ecosystem types. More recently, there has been the development of the Common International Classification of Ecosystem Services (CICES) (Maes et al 2013). Several studies highlight the need not to restrict analysis to direct and tangible benefits, but to include indirect, long-term benefits for society, and to consider how potential services should be accounted for (i.e. the potential for a water body to provide specific services), which matches characterisation in RBMP. Fewer studies consider links between water management and cultural services, though some highlight the need to take a participatory approach to identifying ecosystem services and benefits, which should relate to the stakeholders involved.

SEPA have produced a list of relevant ecosystem services providing a national overview for use in economic characterisation (Annex 4). These set out provisioning, regulating and cultural services of direct relevance to the water environment. The list largely reflects those used in TEEB, but has been expanded to cover some water services (notably abstraction); such that what might be considered to be single services are broken down further. In doing so, SEPA chose indicators or proxies for service provision, while looking to quantify the level of service provision. Each service is considered separately and, where possible service provision is being mapped at the water body level.

Assessment of Ecosystem provision: The most common methods used include GIS mapping to support participative spatial analysis and representation of ecosystem services; Network analysis linking components of the social-ecological system to highlight potential conflicts between competing land uses and different services; Bayesian Belief Networks analysis; and various models that attempt to link measured data and service delivery, particularly using scenarios for examining potential change in ecosystem services.

The importance of the identification of indicators that quantify the provision of services, rather than just the state of the environment is stressed. Indicators should measure magnitude or rate of change of the outcome of ecosystem functions; they need to be quantifiable and reflect changes in land or water use/management. Ecosystem services can be measured via indicators which can be biophysical (e.g. volume/flows/number of species), social (e.g. number of people) or economic (e.g. euros per hectare) and, ideally should examine patterns of ES supply and demand.

Valuing Ecosystem Services: Valuation (not just monetary) is seen to be an important part of an ESA, demonstrating how overall environmental change is perceived and to help clarify synergies and conflicts in people's views of ecosystem services. In practice, this is complex and many projects do not undertake their own valuation, but use biophysical, social and economic indicators to measure ecosystem services. Studies that carried out monetary valuation highlight the disparity in their confidence on the values presented, and warn against using detailed values, relying instead on a simple 3-fold ranking: low, medium, high. They note that monetary valuation might not be an appropriate objective because it can further complicate work and hinder effective engagement.

3.2.3 Recommendations

Characterisation needs to go beyond quantification of current services and look to assess status and potential opportunities. Many studies call for iterative assessments, with regular revision and feedback combining local and scientific knowledge to reduce the impacts of uncertainties and our lack of knowledge on ecosystem functioning. Similarly, several studies warn against using detailed values, relying instead on a simple ranking: Low, Medium, and High.

Whilst it is recognised that SEPA should focus on ecosystem services arising from the water environment, the wider catchment will be considered where it generates a pressure on the water environment, and associated services, and when assessing the benefits that increasing the ecological status of a water body might bring. This will be done at the stage when significant water management issues are addressed in the Catchment Characterisation and Challenges for the Future Report. SEPA are also undertaking a project characterising the ecosystem services provided by soil.

Recommendation 7 – Characterise ecosystem services at a sub-catchment level. **(SEPA to do in-house, now, some additional RBMP and science staff time required) National RBD eventually (see Recommendation 9 below)**

The biophysical area for ecosystem service assessment should be the sub-catchment, made up of linked water bodies. Detailed scale assessment may be needed on selected water bodies identified for individual attention, notably where a service is unique to that location. This would require SEPA to identify priority areas within the AAG region, with water bodies grouped to form sub catchment units. The focus becomes characterising ecosystem service delivery from the water bodies.

Recommendation 8 - As data and assessment of ecological status is currently gathered at the water body scale, SEPA needs to scale up this information and likewise consider pressures at the sub-catchment scale. **(SEPA to do in-house, now, substantial additional GIS staff time required) National RBD (see Recommendation 9 below)**

This would leave the National Advisory Group to focus on determining priorities around strategic services and resolving issues concerning national scale trade-offs for provision of ecosystem services.

Recommendation 9 - The sub catchment approach should be phased in. **(SEPA to do in-house, now, some additional RBMP staff time required).**

Initially prioritise implementing recommendations 7 and 8 in those sub-catchments where AAGs see the highest potential conflict between services and, where appropriate, utilising existing catchment pilots. Recommendations 7 and 8 will otherwise be unattainable within the time periods set for RBMP2 and with the current resources available.

Recommendation 10 - Develop shared national and local lists of Ecosystem Services **(SEPA to do in collaboration with SNH, Scottish Government, Land Use Pilots, now, some additional staff time required for liaison and analysing consultation feedback). National RBD.**

The current work to develop a standard SEPA list, being developed for RBMP characterisation should be shared with others to help identify provisioning, regulating and cultural services of value to a wider group, such as CAMERAS and the two Land Use pilots. A generic 'long list' should be produced

at a national level, with reference to the CICES, covering all ecosystem services relevant to landscape scale environmental management. SEPA should lead development of those associated with the water environment and RBMP. Members of the AAGs and NAG should have opportunity to comment on SEPA's list before it is finalised, so too should the wider public, through consultation via SEWeb. Learning can be had from the experience of the Stirling Ecosystem Pilot and the Rural Land Use pilots as to data availability and acquisition for relevant ecosystem services.

Recommendation 11 - Map ecosystem services using a top-down 'rules-based' characterisation of ecosystem services, with subsequent (15) stakeholder engagement to incorporate local knowledge in the identification, mapping and assessment of ecosystem services. **(SEPA to use consultants to develop rules and mapping algorithms, now, £+75,000 project**). **National RBD**

Local, bottom up engagement is too costly and time-consuming to be applicable across all Scotland; our recommendation is to pilot the use of local groups to assess the additional value of this approach. This stakeholder input would focus on consultation on the outputs of the rules-based characterisation through an interactive process.

Recommendation 12 - The production of ecosystem service maps by SEPA should follow a standard rules-based process (**SEPA to use consultants to develop rules and mapping algorithms, now, £+25,000 project*****).*** **National RBD**

The methodology used as the basis for this mapping process, and the algorithms to convert data available to indicators of ecosystem service provision are for SEPA to determine, in consultation we suggest, with other partners undertaking similar mapping projects. The choice of algorithms for converting available data to spatially-connected measures of service provision is crucial. They must be scientifically robust, sensitive to changes in level of service provision, replicable, transferable, transparent and use available data. Peer-review of potential methodologies is recommended.

Recommendation 13 - Mapping should in the immediate future use available data, but there is the opportunity to explore what other potentially relevant data is available, including proxies, to describe service provision, especially for economic and social areas of activity. **(SEPA to collaborate with partners, but may also need consultants, now, resource unclear – additional staff time but potential licencing agreement costs) National RBD**

The baseline data needed extends beyond the WFD status information for each water body, to other environmental, social and economic aspects pertaining to the water body and, through up-scaling to the catchment. SEPA should initially focus on those services it has already identified through work elsewhere (see above). Cultural services are under-represented and further research is needed to define and measure the key services in a catchment context, though studies have developed their own metrics - see, for example Posthmus et al (2011) - and SEPA are currently exploring their own. It will require greater data sharing than currently occurs between agencies and research organisations (BGS, CEH, the James Hutton Institute, RCAHMS); a challenge to anything other than a pilot approach to immediate implementation.

Recommendation 14 - The outputs from the initial SEPA-led rules-based ecosystem service mapping should be subjected to local stakeholder consultation, in order to incorporate local knowledge in the identification, mapping and assessment of these services. **(SEPA to do in-house**

through AAG officers, RBMP2, additional time to run and write up additional AAG and sub group meetings; plus SEWeb staff time for interactive tools). Pilot sub-catchments.

This should be done in two ways to test the added value of in-depth engagement with local stakeholders. In each case, this should focus at the sub-catchment or water body scale. One using facilitated stakeholder group meetings, and the other interactive, web-based tools. Feedback should be used to assess the potential added value of the more resource-demanding engagement.

Recommendation 15– Facilitated stakeholder engagement should be piloted in selected sub-catchments. **(SEPA to do with consultants working with AAG officers, RBMP2, +£5,000 project) Pilot sub-catchments.**

Stakeholders should be chosen using criteria above, to 'represent' the key ecosystem services within each sub catchment, and those able to influence or impacted by change as done for example, in the Stirling Ecosystem project. Additional stakeholders can be added if relevant during the process.

Recommendation 16 - Using physical maps and GIS showing the results of SEPA assessments of ecosystem provision, each focus group should identify in their own language: the ecosystem services provided by the sub catchment, the location of provision and the likely beneficiaries**. (SEPA to do with consultants working with AAG officers, RBMP2, +£25,000 project) Pilot sub-catchments.**

In doing so, they can indicate which they perceive as being the most important in the context of RBMP and their sub catchment, and comment on the outputs of the earlier rules-based mapping.

Recommendation 17 – The results of the rules-based mapping should be shared with local stakeholders through web-based e-consultation and, more widely SEWeb. (**SEPA to do in-house through IT and AAG officers, RBMP2, additional staff time to generate content and assess feedback) National RBD.**

A standard format questionnaire should be produced, accompanied by the output maps for the relevant sub-catchment asking for comments on inclusion, omission and perceived value of mapped services, and for identification of potential conflicts or opportunities for improvement.

Recommendation 18 - An analysis is undertaken of the added costs and benefits of the enhanced level of engagement in comparison to the remote web-based process (**SEPA to do in house or contract out, end of RBMP2, resource needs unclear*****) National RBD.**

Recommendation 19 - Recognise and capture changes in ecosystem service provision **(SEPA to do in house, RBMP2, see monitoring resources) National RBD.**

The dynamic nature of ecosystem service provision must be recognised, and SEPA should look to build this in to their 6-yearly RBMP cycle, along with stakeholder review (see monitoring section).

Recommendation 20 - Keep valuation simple, using non-financial values **(SEPA to do in-house, RBMP2, additional RBMP staff time to design, pilot and implement valuation techniques) Pilot sub-catchments.**

Valuation of ecosystem services is time consuming and resource intensive, and it is arguable as to how transferable values can be between catchments, between services and over time. Thus while

valuation is important, clarity and simplicity are more so, especially for local stakeholders who need to be included in the process. The economic characterisation for RBMP2 is not currently planning to place monetary values on ecosystem services, rather to categorise them into those that are more or less significant. This will provide useful supporting material for NAG and AAG deliberation, and can be used for ecosystem assessment, plus objective setting (see below).

***Recommendation 21 - Characterisation of ecosystem services should use three levels*. (SEPA to do in house, RBMP2, significant additional GIS time required) National RBD.**

These can simply be termed high, medium or low (similar to the JNCC approach) and be based on best available evidence and expert opinion. Mapping should be at the sub-catchment level.

3.3 Identifying Outcomes and Setting Objectives

3.3.1 Link with WFD cycle and approach in the 1st RBMP

This stage corresponds with objective setting within the WFD process. Objective setting is the process by which a decision is taken on when a failing water body can be expected to meet good ecological status/potential; or the reasons for which a lower objective could be set, following strict derogation criteria. It requires ensuring that healthy water bodies do not deteriorate in ecological status. It is important to understand the relationship between objective setting and selecting a programme of measures. It is impossible to set a final objective without the specific detail of measures used to deliver the objective. This stage will set an initial objective and the output of the next stage would be a final objective. The programme of measures are the means by which the objective for the water body will be met; the cost and technical feasibility of the measures option together with the impact on issues of societal importance being integral to how objectives are set.

The process followed in the first round of RBMP was led by SEPA, with pressures being considered with stakeholders. Information was gathered from stakeholders as to the measures they could deliver to address specific pressures, with an appropriate delivery date (the objective) for achieving this. Where a pressure was identified, but no measure planned, a generic high level measure and measure 'owner' was assigned, and a second or third RBMP cycle objective date allocated, based on SEPA expert judgement and available data. In doing so, SEPA missed the importance of certain ecosystem services which went unrecognised, including the values that local communities place on cultural services, such as recreation and landscape. These were not seen as a key use and one which needed to be embedded within objective setting.

3.3.2 What moving to an ESA might add and involve

The implications of an ESA highlight the importance of ensuring that WFD objectives reflect wider societal values and contribute towards an agreed vision for our water environment. This stage captures that vision. It builds on the characterisation to generate opportunity maps and introduce a transparent and inclusive mechanism for identifying and prioritising locations that could give rise to opportunities to maximise ecosystem service delivery and multiple benefits, and to resolve potential trade-offs between competing services.

Widening the process to include non-statutory goals desired by stakeholders will help build ownership and resilience into the RBMP process. It will align the technical legislative targets with

things that matter to local people, and encourage the identification of complementary opportunities to deliver multiple benefits. The process has two interlinked phases: building consensus around a common vision, and trade-off analyses between competing options. The groundwork for much of the former will have been achieved with the characterisation stage, leaving this stage to focus on future opportunities and trade-offs between different options.

The key step is the creation of opportunity maps, used to identify water bodies in need of restoration. Maps of which can then be overlaid with GIS files that capture information on other aspects of the catchment – development opportunities, environmental improvement projects, recreational areas, etc. suggested by stakeholders. The eventual maps will reflect both their and the agency/local authority inputs. For trade-off analysis, the commonly used approach involves qualitative assessment of the impact of different development objectives upon the range of ecosystem services, using a matrix of actions and impacts. Prioritisation can be based on qualitative assessments or, where available on quantified trade-offs, based on expert judgement and literature sources, and using simple assessment scores (i.e. +/- or ++/--).

3.3.3 Recommendations

The aim is to build a common vision with shared objectives, by identifying opportunities for maximising ecosystem service delivery through capturing synergies in time and location between RBMP objectives and plans, partner organisations' improvement and development policies, and stakeholder aspirations. Just how far SEPA could go beyond RBMP pressures and consider different policy drivers is one area to be explored further in RBMP2. Work such as the Tay catchment opportunity mapping for woodland creation (Broadmeadow et al 2013) provides an innovative way to take account of other drivers at a local scale. At a national scale during RBMP3 cycle, aligning RBMP through an ESA with the policies of partner agencies and government will be important, especially around forestry expansion, flood risk management, conservation of biodiversity, renewable energy generation, agricultural production and development.

All of the recommendations listed here (22-29) are to be implemented within the **Pilot sub-catchments.**

Recommendation 22 – At a national level, identify and map across the key legislation, policies and strategies that will influence the delivery of RBMP2, based on the different types of ecosystem service, and including environmental, economic and social aspects. **(SEPA to do in house, RBMP2, some additional RBMP staff time).**

This can be done as a desk exercise by SEPA and will highlight generic complementary and perverse pressures and drivers of ecosystem service delivery to be addressed at a national and local level. In the longer term, SEPA should add eco-health indicators and work with partners to include issues of deprivation and other social welfare aspects.

Recommendation 23 – Generate an opportunities map at the sub-catchment scale by overlaying the outputs from ecosystem service characterisation (23) with the WFD ecological status and location of water bodies**. (SEPA to do in house, RBMP2, some GIS staff time required).**

This will best be done directly by SEPA using GIS layers.

Recommendation 24 – Overlay this map with information on location and timing of partner organisation improvement plans **(SEPA to do in collaboration with partners, RBMP2, likely to require an additional AAG and NAG sub-group meetings with corresponding staff time requirements plus GIS staff time to generate output layers)**

SEPA would need to access from partner organisations (Local Authorities, SNH, Forestry Commission, etc.) their own improvement and development plans, and add these as GIS layers on the land use base map. A key one, for example will be the mapping of vulnerable flood risk areas and plans for flood risk reduction as developed by Local Authorities. Others include SNH targets for improving the status of nature conservation areas, and FCS opportunity maps for forest planting, such as the Tay pilot for water quality improvement and flood risk reduction.

Recommendation 25 - Ask local stakeholders to provide details of any proposed or desired improvements to the catchment that they wished to put forward, backed by information on location, scale, timing, desired outcomes and the beneficiaries of the improvements. **(SEPA to do in house through AAG officers or using consultants, RBMP2, +£50,000 project)**

This should be done in the pilot areas using semi-structured interviews, and/or structured questionnaires. The map should be overlaid with information on location and timing of partner organisation improvement plans

Recommendation 26 – Analyse rmaps to identify locations of potential synergies for ecosystem service delivery and potential conflicts between improving status of failing water bodies and other partner objectives. **(SEPA to do in house through AAG officers, RBMP2, additional staff time from RBMP and Science teams)**

Recommendation 27 - Circulate the opportunity maps at a community level. **(SEPA to do in collaboration with facilitator/consultants, RBMP2, £+25,000 project)**

Ideally, this could be done as presentations to local Community Councils, in the form of 'Catchment Futures', backed by web-based questionnaires, and a programme of follow up communication with interested, registered participants through SEWeb. Analysis at this stage can only deal with the initial objectives and identify broad scale prioritisation and trade-offs between potential good ecological status/potential and other ecosystem service deliveries.

Recommendation 28 – Assess broad scale prioritisation and trade-off between potential RBMP objectives to achieve GES/GEP with a matrix to highlight impacts of different options on ecosystem service delivery. **SEPA to do in collaboration with facilitator/consultants, RBMP2, £+25,000 project)**

This requires being able to present different options emanating from WFD requirements and from local stakeholder desires and knowledge in a single, cohesive and transparent format, based on ecosystem services. Enabling stakeholders to contribute to the process whereby SEPA wishes to balance its WFD duties with either potential trade-offs between competing ecosystem services, and/or taking the opportunity to realise multiple benefits from aligning synergistic initiatives with priorities for WFD. Such a matrix would look at *marginal changes* from the current position in relation to potential improvement, or setting of a lower standard (GEP). This would require a

pressure by pressure basis, recognising that certain water bodies are naturally linked and will need to be treated together.

***Recommendation 29 - Working with pilot sub catchment focus groups, create a simple matrix using a ++/-- scoring will enable the nature and extent of overlap and conflict to be readily seen*.** **(SEPA to do in collaboration with facilitator/consultants, RBMP2, resource £+25,000 project)**

The locations where the proposed actions to improve failing status can be assessed jointly as to (a) their ability to deliver a range of ecosystem services; (b) the opportunity for other ecosystem services to be achieved at the same time and location (multiple benefits), and (c) the existence, or potential existence of competing ecosystem services (ones that would be damaged as a result of the proposed project). This process will reveal where potential clashes and delivery of multiple benefits could occur, and who are the relevant stakeholders impacted by any of these options.

In the hypothetical example below, consideration is given to improving a water body failing due to diffuse agricultural pollution. The potential areas of synergy and conflict can readily be seen, the importance being the comparisons between and the marginal changes, not any absolute values.

Ecosystem Services	Current benefits to people	Improve to GES in RBMP2	Delay to RBMP3
Food provisioning	Food	**--**	**-**
Water supply	Fresh water	**+**	**0**
Flood risk reduction	Flood control	**+**	**-**
Water quality	Nutrient reduction	**++**	**+**
Climate control	Carbon storage	**+**	**-**
Landscape	Aesthetic	**+**	**-**
Recreation	Cultural enjoyment	**+**	**0**

Table 1. *Predicted marginal changes to Ecosystem services, expressed as positive (+), negative (-), neutral (0) or unknown (-) from improvements to a water body impacted by diffuse pollution*

In this hypothetical case, delaying WFD improvement to GES would have far less benefits than immediate improvement in RBMP2. In raising ecological status which was failing on water quality, a synergistic improvement is observed in recreation, landscape and flood risk reduction. The significant negative impact will be on food production as a provisioning service.

As well as framing the issues, the use of a matrix can help build consensus around desired outcomes and priorities. It may identify at an early stage the respective roles that SEPA and other bodies (locally and nationally) could take in delivering outcomes (including incentives and/or regulation), though this will be more apparent during consultations on measures.

SEPA has, to date focused on the environmental benefits of achieving (or not achieving) good ecological status in deciding options, and the costs (disproportionate cost tests etc.) associated with them. Less emphasis has been laid on non-environmental benefits, and it is this that such a matrix approach may help to highlight. Crucially it will do so in an open and transparent manner, and include local and informal knowledge. Use of a matrix is an iterative process; it is not necessarily a case of looking for the win-win situations, but making clear and transparent choices.

The matrix in itself does not take forward any ideas of financial cost/benefit. What the ESA does do is highlight the areas of potential economic, social and cultural (ecosystem service) benefits and dis-benefits that should be included in an economic cost-benefit analysis.

3.4 Selecting and Implementing Programmes of Measures

3.4.1 Link with WFD cycle and approach in 1st RBMP

This stage corresponds with the step, *selecting a programme of measures*, of the WFD process. These are the suite of measures (regulatory and voluntary actions) implemented by stakeholders to maintain or restore GES/GEP. The issue is prioritising how best to implement the measures so as to choose the most appropriate suite of actions to achieve the desired outcomes identified in the previous step. It is important to note that this step is interdependent with the previous step, initial objective setting. The measures are the means by which the objectives will be met and problems with technical feasibility, affordability or societal acceptability might mean that less stringent objectives will be required. Unless one knows the exact nature, acceptability and impact of the measures to be adopted, the final achievement of the objective may be hard to determine.

Whilst timely and efficient, the selection of PoMs most suitable to achieve outcomes/objectives in the first cycle of RBMP could have benefitted from greater stakeholder engagement. It also suffered from scientific uncertainty as to measure effectiveness, making it difficult to prioritise the most effective measures and where to focus them. Similarly, lack of methodologies hampered the ability to take into account the potential wider benefits accrued from the selection of particular POMs to improve ecological status of a failing water body. These might have led to the delivery of multiple benefits at the same location and time, but went unrecognised.

3.4.2 What moving to an ESA might add and involve

The ethos of an ecosystem approach mandates participation and utilising local knowledge. Integration of local knowledge into the process is the key to harmony, added value, realisation of multiple benefits and option appraisal. Stakeholder input to selection should identify where measures are economically or culturally problematic and where alternatives might work better. A focus on ecosystem services broadens the process beyond the WFD parameters for GES/GEP, identifies where measures might provide additional benefits important to stakeholders, and helps deliver other policy objectives. Measures which deliver benefits that matter to stakeholders should aid uptake and wider societal support for RBMP, and help position RBMP measures better within existing funding mechanisms, such as the Scottish Rural Development Programme.

The full list of POMs available for use in RBMP are grouped around the five main pressures on the water environment SEPA identified – water quality; water supply; water flows and levels; barriers to fish migration and pressures on banks, beds and shores; and invasive non-native species. Within each, a series of examples are given of 'on the ground actions', such as Control at source; Collect and treat; Prevent entering a watercourse; Intercept and store; etc. Within each of these, are another set of example options - install buffer strips; capture polluted run-off from steadings; install new slurry storage facilities, etc. Separately, the potential mechanisms for achieving these actions are framed under three headings – Legislative; Economic, Education and Advice – and again a number of initiatives and options are listed.

3.4.3 Recommendations

The current approach in WFD requires measures to be assigned for each individual pressure, rather than at a catchment level. An ESA will examine the measures assigned to all relevant pressures in a sub-catchment, to identify where opportunities exist to coordinate delivery. It is the type and specific location of measures in the catchment that affects how it delivers or impacts upon ecosystem services. Ideally, the relevant group of local stakeholders can be encouraged to come together to agree the measures (means) by which the objectives can be achieved.

This is an iterative process; it will be necessary to return to stage 3 and revisit the objectives once the detail of the measures has become clear. Given the detail and nature of this process, this should only be undertaken in the pilots in RBMP2.

Recommendation 30 – Establish a standard list of measures, with identified potential impacts (positive, neutral or negative) on SEPA's list of ecosystem services. **(SEPA to do and consult with partners and LUS pilots, RBMP2, some additional RBMP staff time required) National RBD.**

Such a checklist was used for climate change screening in RBMP1. It would be useful to draw on the results of another CREW project which looked at the Scotland Rural Development Programme 2014-20 – assessing water and soil quality options, their evidence base and potential to deliver multiple benefits. In addition, SEPA may review POMs in terms of their sustainability, and life cycle – favouring source control, then pathway and finally receptor resilience.

Recommendation 31 - For each pressure/water body where improvement is proposed, with local stakeholders jointly score the changes to ecosystem services that would be expected from selecting each of the POM options. **(SEPA to do in collaboration with facilitators/consultants, RBMP2, £+50,000 project) Pilot sub-catchments.**

This relies on knowledge held by working groups regarding links between measures, ecological functions and delivery of ecosystems services. As it is highly unlikely, and probably unnecessary, to have detailed values for each service, a simple scoring system (++/--) will suffice. As and when SEPA produce new tools for economic characterisation of ecosystem services, these values can be substituted to improve it. The stakeholders for each potential water body/sub-catchment will have to be brought together as a Focus Group to work through the table. Training and support may be necessary to get best value from their inputs.

Recommendation 32– Use a simple tabular matrix to compare scores for different POM options. **(SEPA to do in collaboration with facilitators/consultants, RBMP2, £+25,000 project) Pilot sub-catchments.**

SEPA should use a simple matrix, similar to that used in trade-off analyses. The number of criteria for comparison can be increased over time to add details on the cost of measure, who bears that cost and who are the providers and beneficiaries of the services.

Individual Water Body - Ecosystem Services present or potentially present	Current benefits to people	Impact of measure (1) - Manage nutrient use to minimise losses	Impact of measure (2) Implement in-field measures to reduce sediment erosion and loss	Impact of measure (3) Install buffer zones, including wetlands and woodlands
Food production	Food	++	+	-
Water supply	Fresh water	+	+	+
Flood risk reduction	Flood control	0	+	++
Water quality	Nutrient reduction	++	++	++
Climate control	Carbon storage	0	0	+
Landscape	Aesthetic	0	+	++
Recreation	Cultural enjoyment	0	+	++

Table 2. Hypothetical example of impact on ecosystem services of potential measures to improve a water body failing from diffuse pollution, expressed as positive (+), negative (-) or neutral (0).

The list of potentially viable options will be unique to every water body and to the specific cause of failure to reach GES/GEP. In this instance, the three measures are assumed to be as effective as each other in achieving the desired outcome for GEP and shows that measure (3) provides extra benefits to the largest number of ecosystem services, but has a cost to food production.

This approach offers a way to consider how choices made at one water body might influence GES/GEP and wider benefits throughout the catchment, and thus captures some of the impacts produced by cumulative and co-located actions to improve individual water bodies. It will be possible for SEPA, using GIS mapping and simple decision rules to identify whether the impact is felt upstream, adjacent (wetlands/groundwater) or downstream; and how far the impact will travel. This is particularly clear for the removal of barriers to fish migration where the impact of removal being directly related to the location of the barrier and of any neighbouring barriers (see Gilvear *et al* (2013) for an example of how to optimise the choice of method and location of measures for maximum effect on restoring ecological function). This process will identify where a measure is best positioned from a technical perspective. Economic and social aspects also need to be considered.

In essence this is a type of Multi Criteria Analysis (MCA), an approach that can assist option appraisal, as undertaken in the Forth Multiple Benefit project. Further analysis is currently being undertaken by ADAS to look at effectiveness of measures. It could be undertaken, building on the simple matrix approach described, supported by cost benefit analyses of undertaking different combinations. MCA can be qualitative or quantitative, simple or complex, weighted or un-weighted. It is a step that could be trialled in RBMP2 with differing levels of data and complexity, but would require more resources, particularly time in stakeholder meetings, than is available.

***Recommendation 33 – Chose the most cost-effective measures to deliver GES, taking into account the 'net' benefits from delivery of 'extra' ecosystem services*. (SEPA to do in-house through AAG officers, RBMP2, some additional staff time required) Pilot sub-catchments.**

If the costs of POMs are still disproportionate, then consideration should be given to changing objectives and re-assessing.

As the case studies illustrate, promoting voluntary uptake of measures by stakeholders is not always easy. A process of stakeholder deliberation to establish under what conditions a measure would be acceptable in that location; and what incentives or procedures would promote uptake will be required, and is currently being explored by SEPA. In essence, this would be the next step of engagement following directly from the matrix above. It could be trialled but is likely to take more resources, particularly time, than is available.

3.5 Monitoring and Evaluation

3.5.1 Link with WFD cycle and approach in 1st RBMP

This stage corresponds with the final steps. A new challenge is to be able to measure and predict the changes in ecosystem services that will result from improving the ecological status of a failing water body. Whilst WFD monitoring is aimed at assessing the state of the environment, an ESA would focus on ecosystem service delivery. Furthermore, the parameters included in monitoring for RBMP1 were mainly environmental, rather than economic, societal or cultural.

Separately, in any process, and particularly one that has a cyclical nature with successive RBMPs every six years, evaluation of RBMP itself is required in terms of internal processes, outputs and outcomes, including the resources utilised, the procedures, the timings and stakeholder involvement.

3.5.2 What moving to an ESA might add and involve

An ESA requires expanding the parameters monitored for WFD compliance to include indicators linking ecological function to ecosystem services and the benefits derived from these. There are challenges in attempting to monitor dynamic systems, and the complex nature of ecosystem service delivery must be recognised. Assumptions about linear improvements of service delivery and status may be unrealised, and services may have tipping points. A baseline assessment, using existing data to characterise current service provision will provide a benchmark against which to monitor change. However, for many services a time lag exists between changes in management and ecosystem service delivery, such that modelling may be required to predict likely changes.

The centrality of participation and use of local knowledge leads to the need to review the appropriateness of stakeholder engagement processes and whether they have helped integrate multiple forms of knowledge and created consensus/diffused conflict. The results of trialling greater in-depth stakeholder participation in the sub-catchment pilots will also need evaluation.

3.5.3 Recommendations

SEPA needs to evaluate the effectiveness and acceptability of the ESA process for RBMP; and its impact on the environment. Ecosystem service monitoring is the subject of a separate SEPA work stream project, but here it needs to cover project management activities and processes on the one hand and outcomes, in terms of changes in ecosystem service delivery on the other.

Recommendation 34 - SEPA should monitor changes in ecosystem service delivery at the water body level using an agreed set of indicators. **(SEPA to do in house, RBMP2, resource implications depend on which additional indicators are selected and costs of monitoring them) National RBD.**

These should be developed with SNH and other partners, including the Rural Land Use Pilots in Aberdeenshire and the Borders. They should focus on changes that would be expected consequent on improvements to WFD status.

Recommendation 36 - The development of new indicators, especially for cultural services and for societal and economic aspects is a priority for research. **(SEPA to do in collaboration with consultants, partners and LUS pilots, RBMP2, £+75,000 project) National RBD.**

Some services are very poorly represented, even with proxies. The opportunity should be taken to explore how ecosystem service delivery maps against societal and economic indicators of deprivation and well-being. This should be integrated with similar initiatives for Natural Capital monitoring being taken forward by Scottish Natural Heritage, and others.

Recommendation 37 – Monitoring should include data collected for the SWMI report, and now through CCCF, for WFD monitoring of ecological status. **(SEPA to do in house in collaboration with partners, RBMP2, significant additional staff time required) National RBD.**

To this needs to be added information derived from land use/habitat maps; soil and slope information; agricultural capability; protected conservation sites; historic monuments; sites of recreational importance; economic activity; and cultural significance. Working with Scottish Government, the Borders and Aberdeenshire Land Use pilots have developed a comprehensive list of potential data sources and their alignment to ecosystem services. SEPA should liaise with these projects to access and review the monitoring of these lists.

Recommendation 38 –SEPA should evaluate the ESA process through annual questionnaire surveys for AAGs and local stakeholder communities. **(SEPA to do in house through AAG officers, RBMP2, some additional staff time required) National RBD.**

A web-based questionnaire should provide feedback on process, outputs, outcome and consensus building.

Recommendation 39– SEPA should monitor monetary and non-monetary costs and benefits of enhancing ecosystem service delivery in the pilot sub-catchments. **(SEPA to do in house or contract out, RBMP2, significant time required to design, implement and analyse the evaluation £+50,000)**

As an ESA will require greater investment in time and resources, the extra costs and time to deliver the sub-catchment pilots needs to be assessed.

4 CHALLENGES, RISKS AND OPPORTUNITIES

This section captures some of the overarching issues to consider when deciding if and how to adopt an ESA approach to RBMP. Generic advantages and challenges have been addressed earlier in this report, and so this focuses on issues of direct relevance to the challenges facing SEPA in adopting a new approach to something as complex, technical and resource-hungry as RBMP. There are also opportunities to use this process to deliver additional policy objectives, build better partnerships at a catchment level and practice greater decentralised and participatory water resource management.

4.1 Challenges and Risks

Moving towards an ESA within WFD and wider catchment management raises a number of significant challenges and risks. In itself, little of ESA is either new, or revolutionary. It brings a new framework, a new language and a new perceived complexity to the management of natural systems, at a particular scale. It focuses on systems, predominantly natural, but attempts to link these to human social, cultural and economic systems – expressed as human well-being. Existing conflicts and challenges over resource partitioning, valuing of the environment and political direction still remain.

The most significant challenges are:

- The uncertainties around the identification and measurement of ecosystem services
- Data issues in terms of accessibility and availability for ecosystem services
- The timescales within which the process has to be fitted to achieve integration with the RBMP process
- The resources that will be needed, especially to effectively engage with stakeholders
- Maintaining the interest and good will of stakeholders
- Managing expectations from greater stakeholder engagement in the wider process
- The fit of ESA within RBMP and with other policies and activities occurring within catchments
- The integration of top-down outputs and bottom up desires
- The language of ecosystem services.

The choice of a number of pilots was highlighted by the workshop participants as being a particular challenge. Piloting was seen as the best way to learn how an ESA worked, and from this to be able to assess the resources and other challenges facing SEPA were the ESA to be rolled out nationally for RBMP3. The importance of managing the process of pilot selection was seen as important and, whether or not there was a need for new pilots, careful attention needs to be paid to ensure the pilots are capable of answering the questions required, and that evaluation is robust.

The need for integration and to join up the national SEPA-led 'top-down' processes (RBMP agenda-setting, WFD timetables, data production, ecosystem service mapping, outputs, etc.) with encouragement of 'bottom-up' stakeholder engagement and inputs needs careful consideration. Local engagement is time and resource heavy. It may be unclear precisely what the bottom-up process will add and to what extent it will be a good use of resources. However, without real engagement, stakeholder communities will not accept the process and will not become involved. In

A robust process for managing feedback received from stakeholders is required. The bottom-up processes integral to the pilots can be used to revise and reframe the top-down approach. Opportunity mapping/characterisation needs to consider potential changes and opportunities, and as noted in the Stirling project, there is a gain in terms of engagement and support to be grasped by stressing the local benefits to be had from the environment (farming, recreation, flood storage, etc.), rather than the achievement of a somewhat nebulous WFD status.

Maintaining the interest and participation of stakeholders in the process is a key issue and expectation management may need to be a specific consideration for SEPA. Not only is it necessary to counter stakeholder fatigue, it is also important not to raise expectations as to imminent delivery of whole scale environmental, social or economic improvements arising from the process.

Delivery of multiple benefits will need to embrace regulatory and voluntary actions, and not just those restricted to RBMP. To date, SEPA has focussed mainly on RBMP environmental benefits, indeed primarily those that contributed directly to achievement of GES. One of the learning points from many ESA studies is that effective engagement with stakeholders beyond the immediate government and agency organisations requires the statutory bodies to consider their ability and willingness to at least partially 'let go' of their pre-determined timescales and statutory obligations. Only by doing so will they engender positive support from others to assist with 'their' agenda. However, SEPA also have to deliver WFD, and will have to manage the interface between 'top down' RBMP legislative direction and 'bottom-up' stakeholders' desires to promote their own agendas.

Extending this process further to embrace other policy areas, and to regulating, provisioning and cultural services is a big challenge. Not least is the need to explain the 'new process' both internally and externally – and to ensure that why it is worth doing and who benefits is clearly understood. In some cases, there may be good agreement as to what needs doing, but not on the methods or measures necessary, or the timescale. In others there may be little agreement at all, and limited opportunity for real trade-offs.

Any change in current process to incorporate an ESA will have to fit within the RBMP timetable. Given the fixed nature of the 6-year RBMP cycle, this effectively means a 'window' of some 9-12 months, sometime after production of the CCCF report and before the production of the draft river basin management plans.

A further factor concerning timescales relates to the nature and response of ecosystem services themselves. Improvements to the state of a water body, as measured by biological or chemical parameters can be assessed relatively easily, and much is known about the time taken for water body status to physically respond to measures. The regulation of a polluting discharge, the control of invasive non-native species or the restoration of physical habitats can be planned, implemented and assessed within a single RBMP cycle. There is not the same certainty surrounding the response of ecosystem services to measures. In many cases, the only measures available will be indicators or proxies for the service represented, and changes in service provision may take years to become visible. This may be particularly true of some of the cultural services where changes in the value a community places on a particular service may take much longer to be realised.

In the immediate future, availability of, and timely access to, relevant new data sets at the scale necessary for analysis will be a challenge. This is particularly true of data sets held by commercial

research institutes and organisations. Experience with the Land Use pilots and Stirling Ecosystem Services project show that even data sets held by the project partners have been hard to access. Beyond this, data sets held by institutes such as BGS (groundwater, geology), the James Hutton Institute (soils, agricultural capacity), RCAHMS (historic landscapes), Scottish Government (agricultural statistics, farm payments), CEH and others are 'protected' by commercial licences. Time, expense, security issues are real barriers to improving the quality of information on ecosystem service provision.

Data availability and quality is further compounded by the challenge that ecosystem services are delivered at multiple scales and the benefits received at different scales, making effective mapping difficult. Values may also need to be extrapolated over large areas between point locations where the data were collected. The use of stakeholders to 'sense' check maps is recommended, both at a local level and more generally.

One issue is that the majority of literature relevant to water management and ESA focuses on managing surface waters. It is less clear how to ensure that groundwater water bodies are integrated into the processes above.

A final challenge may be more a technical one, relating to the legal basis within which derogations or delays in achievement of good ecological status could be taken forward. Notwithstanding the view expressed in the ONEMA report, informal legal advice suggests that the use of ecosystem services to make a case for derogation may not be relevant, so it may be that they could not be used as a reason. WFD Article 4 exemptions could be used (such as disproportionate costs etc.) where they had been identified in advance, but the suggestion is that ecosystem services themselves could not.

4.2 Opportunities

The ESA brings significant opportunities, not least because of its focus on systems, services, flows and integration, rather than on silos, the state of the environment and a top-down, regulatory approach to improvement. Some of the main opportunities include;

- Better use of money and other resources
- The achievement of multiple benefits
- Aligning community aspirations (bottom-up) with top-down regulatory priorities
- Integration and shared learning with the two Pilot Land Use Strategy projects
- Engaging with stakeholders and empowering them to act to improve their communities, potentially through greater use of 'trusted intermediaries' such as Tweed Forum
- Promoting the links between environment, economy and society at national and local level
- Promoting deliverables for integrated catchment management in respect of potential benefits to flood risk management, rural development, tourism, recreation, sustainable farming and conservation of biodiversity, among others.

SEPA have already moved to realise some of these opportunities through their lead and support for partnership work in priority and pilot catchments. This includes increasingly integrated work on combatting diffuse pollution, habitat restoration and natural flood risk management in such

locations as the Eye Water, Eddleston Water, and the Tarland. Alongside this, an ESA will assist with prioritising river restoration work and directing resources from the Water Environment Fund.

SEPA has the opportunity to lead the way in demonstrating the gains to be made from embedding ESA within RBMP, trialling elements in RBMP2 and developing further in RBMP3. In particular it can address what were seen as weaknesses in realising the potential for delivery of multiple benefits alongside improvements in ecological status, and recognition that communities place many other values on the water environment. The opportunity exists to utilise the CCCF reports to help identify and capture a wider set of benefits and dis-benefits across a whole catchment, and assist in the management of trade-offs between competing interests and services.

The process SEPA has put in place is still largely an inwardly-led one focusing on the targets of RBMP and, to a lesser extent on other legislative and policy pressures. As we move towards RBMP2 and RBMP3, there is an opportunity to bring other stakeholders on board, and to foster a truly "bottom-up" approach. Through this enhanced level of engagement SEPA will be able to capture the issues and services seen as important by local communities and others with a valid interest in sustainable catchment management in its widest environmental, economic and social sense.

Use could be made of the two Land Use Strategy Pilot studies. Their work on mapping of ecosystem services and stakeholder engagement through a trusted intermediary, such as Tweed Forum (rather than SEPA or another agency of government) will provide an excellent detailed and comparative process of which RBMP should take full advantage.

4.3 Final Recommendations:

For SEPA to take on all these recommendations and further development across Scotland would be too great a challenge. Whilst elements can be taken forward at a national level, it will be necessary to trial the intensive approach in a small number of pilot areas this RBMP cycle at the sub-catchment level.

The choice of sub-catchments should reflect the environmental and ecosystem service challenges across Scotland to enable us to understand why and how different communities value their water environment and GES. This should include consideration of the two Land Use Pilots; the 14 priority catchments for diffuse pollution control; the new pilot catchment projects for morphology and natural flood management; as well as other existing studies including those on the Allan, Eddleston and Bowmont; the Tay Woodland Opportunity Mapping project; Scottish Water catchment initiatives; and those in urban landscapes (Central Scotland Green Network).

As these projects develop, SEPA may wish to review the governance model with which it has so far progressed. Whilst delivery of WFD must remain the fundamental objective and responsibility of SEPA, as the EA's 15 Catchment pilots have shown, other organisations could play a leading role in delivering RBMPs at the local scale of sub-catchments. Organisations such as Local Authorities, SNH, Rivers Trusts, Tweed Forum, etc. could become more engaged, enabling better alignment of policies and resources, improved shared learning on issues such as the best way to engage with communities "bottom up" and to tap in to the resources, desires and knowledge of others.

A longer-term challenge to consider is the extent to which SEPA wish to take an integrated land and water management approach delivering an ESA involving the values of all stakeholders, or restrict the debate to only those services of direct relevance to the water environment. Results for the EA Catchment Pilots portfolio (2012) highlight the importance of not being totally focussed on WFD. Their top tips include "collation of aims/objectives of all stakeholders for the catchment irrespective of WFD targets at the start" and "don't just focus on WFD related issues as this will alienate some stakeholders that don't specifically work on it".

Looking to the future, there are clearly several areas where research and development are still needed, and these should be articulated and followed up. These include:

- The development of new and improved indicators of ecosystem service delivery;
- The mapping of current and potential ecosystem services from failing and improved water bodies in relation to deprivation indices and other socio-economic and health indicators;
- The roll-out and evaluation of the pilot projects;
- The use of web-based communication, including SEWeb and social media, to enhance stakeholder engagement and feedback;
- A greater emphasis in language and focus on benefits received from healthy ecosystems and opportunities to improve local communities;
- Legal advice on whether delivery or damage to ecosystem services could be used to justify derogation; and
- Further exploration of the MCA approach and life-cycle analysis in assessing options for objectives and measures.

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6 ACRONYMS

AAG Area Advisory Group

BGS British Geological Survey

BTCV British Trust for Conservation Volunteers

CAR Controlled Activity Regulations

CCCF Current Condition and Challenges for the Future report

CEH Centre for Ecology and Hydrology

CICES Common International Classification of Ecosystem Services

CREW Centre for Research Expertise on Waters

CSIRO Commonwealth Scientific and Industrial Research Organisation

Defra Department for the Environment, Food and Rural Affairs

ESA Ecosystem Services Approach

ES(S) Ecosystem service(s)

GEP Good Ecological Potential

GES Good Ecological Status

GIS Geographical Information System

HMWB Heavily Modified Water Body

IUCN International Union for the Conservation of Nature

IWRM Integrated Water Resource Management

JNCC Joint Nature Conservation Committee

LWEC Living With Environmental Change

MA Millennium Assessment

MCA Multi-Criteria Analysis

MImAS Morphological Impact Assessment System

NAG National Advisory Group

NERC BESS Natural Environment Research Council Biodiversity and Ecosystem Services Science

NGO Non-Governmental Organisation

ONEMA The French National Agency for Water and Aquatic Environments

PES Payment for Ecosystem Services

POMs Programmes of Measures

RBD River Basin District

RBMP River Basin Management Plan

RBMP1/2/3 River Basin Management Plan 1st, 2nd, 3rd cycle

RCAHMS Royal Commission on the Ancient and Historical Monuments of Scotland

RESAS Rural and Environment Science and Analytical Services

SAC Special Area of Conservation (under the EU Habitats Directive)

SEPA Scottish Environment Protection Agency

SEWeb Scotland's Environment Web

SNH Scottish Natural Heritage

SPA Special Protection Area (under the EU Wild Birds Directive)

SRDP Scottish Rural Development Programme

SSSI Site of Special Scientific Interest

SWMI Significant Water Management Issues

SWOT Strength Weakness Opportunity Threat

TEEB The Economics of Ecosystems and Biodiversity

UNEP United Nations Environment Programme

UKNEA United Kingdom National Ecosystem Assessment

WFD Water Framework Directive

WWF World Wildlife Fund

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8 ANNEX 1: METHODOLOGY FOR THE STUDY

Stage I - Literature search and review of material from case studies. A wide range of potential case studies were identified, and subsequently prioritised for analysis. A draft report from this was produced, giving extensive details of the projects reviewed under the headings of Objectives and Drivers; Methodologies for ESA; and Public participation.

A synthesis set out a bullet points classified into themes, issues and lessons to be drawn from these studies, and formed the basis for discussion with SEPA as to the key messages arising.

Stage II - Proposal of a framework for analysis of WFD and ESA. This included:

- the steps within the RBMP decision-making process against which an ESA should be matched;
- the elements of an Ecosystem Approach and ESA that SEPA recognise as being relevant to the overall process, and to each individual step; and
- the success criteria by which suggested recommended ways forward should be judged.

The following criteria were seen as the most relevant for assessment of the more feasible techniques, and the extent to which they:

- could be integrated within existing SEPA processes;
- fit within set and tight time-frames for WFD delivery;
- do not involve significant additional resources;
- do not involve major alterations to governance structures;
- would be acceptable to key external stakeholders;
- can be expected to make a demonstrable impact on the process and outcomes; and
- would lead to the delivery of additional benefits.

This enabled an assessment of the benefits and drawbacks of the mechanism to SEPA, the feasibility of adoption under current circumstances, and the risks of not using this approach. Consideration was given to how and why SEPA might adopt processes in the future if not currently feasible.

Stage III- Production of a draft methodology for integrating ESA within the current RBMP process for Objective Setting. This was accepted by the project team as a template for further work. The need to identify the ideal approach, and highlight practical recommendations for SEPA was stressed.

Stage IV - Production of a full, draft report. This was used as a basis for further review and discussion, and for utilisation in designing the workshop in stage V.

Stage V - Workshop with SEPA staff on May 7th. Designed to help refine recommendations on how best to use an ESA to implement river basin planning and catchment management. The invitees were selected for their perspective on different aspects of SEPA operations that might have a stake in using an ESA for RBMP and catchment management, along with representatives from Scottish Government and Scottish Natural Heritage.

Stage VI – Production of final draft report for review. The report was peer-reviewed by the SEPA steering group (Louise Bond, James Davidson, Shona McConnell, Scot Mathieson and Rebecca Badger) and the James Hutton Institute project manager (Kirsty Blackstock). A final version was prepared that responded to these comments.

9 ANNEX 2: CASE STUDIES REVIEWED WITH WEB ADDRESSES AND MAIN PUBLICATIONS

Potential case studies for review were assessed by Dundee, SEPA and the James Hutton Institute. This focussed on identifying the potential relevance of each, and the key learning points SEPA wanted to explore and understand. Case-studies were prioritised in to three groups for analysis:

a) Stirling Ecosystem Project; DEFRA Demonstration Test Catchments (Eden, Avon and Wensom); EA's ecosystem service studies for RBMP (Wandle, Ray and Tamar); NE upland Ecosystem Pilots (Bassenthwaite, Yorkshire, Southwest); Parrett catchment; CSIRO. Investigation was made of the EA's strategic work and their project on RBMP ecosystem services process mapping.

b) Clyde and Forth valleys multiple benefits; ESAWADI; ONEMA; OpenNESS; 5 East of England Local Authority studies; SuRCaSe; Polyscape (Bangor university); Welsh ES mapping case-studies (national/Bridgend); Beckingham marshes; URSULA (Sheffield)

c) Parts of the following studies: South West Water/West Country Rivers Trust Upstream Thinking; Frome and Piddle; JNCC Irish Sea; Thanet Natura 2000

It was recognised that there were several projects in progress, including the major review of Tools Applications Benefits and Linkages for Ecosystems (TABLES), being undertaken by Birmingham City University; the EU RESTORE project and the Tay Forest Opportunity Mapping Project.

Case Studies

Group a)	Web site	Reference
Stirling Ecosystem Project Explores options and recommends an integrated method for undertaking a project based on the ecosystems approach at a local scale in the Carse of Stirling. Detailed review and roll out of intense local stakeholder engagement around multiple ecosystem services, identified as benefits from nature.	http://www.snh.gov.uk/publications-data-and-research/publications/search-the-catalogue/publication-detail/?id=1966	Land Use Consultants (2012). Stirling Ecosystem Project Proposed Methodology James, N., Roxburgh, C. & Orr, S. (2013). Applying an ecosystems approach to land use – Stirling ecosystems approach demonstration project: Developing a methodology. Scottish Natural Heritage Commissioned Report No. 532.
DEFRA Demonstration Test catchments (Eden, Avon and Wensom) exploring how to reduce the impact of diffuse pollution on ecological function while maintaining sustainable food production	http://www.avondtc.org.uk/http://www.wensumalliance.org.uk/ http://www.edendtc.org.uk/http://www.catchmentchange.net/wp-content/uploads/2010/01/Bob-Harris1.pdf	
EA Catchment Guide	http://www.environment-agency.gov.uk/research/planning/148309.aspx	EA Catchment pilots Portfolio (2012)

Environment Agency EA's work on ecosystems approach and integrating with WFD. Captures a series of individual projects and explores a strategic approach to ESA and WFD.	http://ipbes.unepwcmc-004.vm.brightbox.net/system/assessment/194/references/files/569/original/Using_science_to_create_a_better_place_-_ecosystem_services_case_studies_2009.pdf?1364317641 http://www.wskep.net/assets/documents/v2_WFD_and_ESS_Paper_270213.pdf	Everard, M., (2009). Ecosystem services case Studies. Environment Agency Science Report SCH00409BPVM-E-P. Bristol Vlachopoulou, M, Coughlin, D,Forrow, D, Kirk, S., Logan, P. and Voulvoulis, N. (2013). The potential of using the ecosystem approach for WFD implementation.
Upland Ecosystem Pilots (Natural England) Reports on experiences gained from implementing the first phase of Natural England's three upland ecosystem services pilot projects (Bassenthwaite, South Pennines and South West Uplands), from summer 2009 to March 2011. Provides practical examples demonstrating how the ecosystem approach can be applied on the ground; and use of an ecosystem approach to define land and water management based upon consultation with stakeholders and their perceptions of the best options.	http://naturalengland.etraderstores.com/NaturalEnglandShop/NE225 http://publications.naturalengland.org.uk/publication/4084624	Natural England (2011). Monitoring and modelling ecosystem services. WATERS, R. D., LUSARDI, J., & CLARKE, S. (2012). Delivering the ecosystem approach on the ground – an evaluation of the upland ecosystem service pilots. Natural England Research Reports, Number 046. Haines-Young, R., Potschin, M.; Rollett, A. & Tantram, D. (2010). England's upland ecosystem services. Phase I Report to Natural England NECR 020. 114 pp.
Parrett Catchment Examined how an Ecosystems Approach could be used within an English region at the catchment scale, and the tools and methodologies required.	http://www.nottingham.ac.uk/cem/pdf/NR111_FTR_CEM-08-09-08.pdf http://www.defra.gov.uk/environment/policy/natural-environ/research/case-studies.htm http://www.catchmentfutures.org.uk	Potschin, M., Fish, R., Haines-Young, R., Somper, C. & Tantram, D. (2008) The Parrett Catchment: A case Study to develop tools and methodologies to deliver an Ecosystems Approach (Catchment Futures). Full Technical Report to Defra, Project Code NR0111
CSIRO's case studies on ecosystem service provision	http://www.ecosystemservicesproject.org/html/case_studies/index.htm	
Group b)	***Website***	***Reference***
Clyde Valley Green Network and multiple benefit projects SEPA Commissioned project 'Ecological networks & RBMP- Clyde pilot study' - to develop an approach to align river basin planning objectives with an Integrated Habitat Network Model for the Clyde Valley.	http://www.sepa.org.uk/water/river_basin_planning/area_advisory_groups/clyde.aspx#pilot; http://www.gcvgreennetwork.gov.uk/	Entec (2010). Green Networks and RBMP Opportunity Mapping
Forth RBMP multiple benefits projects Spatial analysis to identify areas where	http://www.sepa.org.uk/water/river_basin_planning/area_advisory	JBA (2012). Delivering multiple benefits through RBMP in the

opportunities exist to deliver water environment restoration projects which could deliver multiple benefits. Aim to identify sites, which, if restored, would improve the ecological status of the water body by addressing RBMP pressures AND in doing so would also strengthen and increase connectivity of woodland, wetland and grassland integrated habitat networks.	_groups/forth/forth_multiple_benefits_projec.aspx	Forth Sub-Basin District.
Central Scotland Green Network	http://www.centralscotlandgreennetwork.org/	
ESAWADI Linkis the economic elements and requirements of the WFD with the valuation of ecosystem services	http://www.esawadi.eu	ESAWADI (2010) Framework of Analysis Work package 1: inception and work on common understanding and methodology
ONEMA The French National Agency for Water& Aquatic Environments - recommendations on how ecosystem services can be used and valued, for integrated watershed management as well as for WFD implementation based on a collection of tangible examples in Europe.	http://www.onema.fr/IMG/EV/meetings/ecosystem-services.pdf	Wallis, C, Seon-Massin, N, Martini, F & Schouppe M (2011). Implementation of the WFD: When Ecosystem Services come into play. 2nd Water Science meets Policy, Brussels, 29/30th September 2011.
Operationalisation of Natural Capital and Ecosystem Services ***(OpenNESS)*** **-** EU project aims to translate the concepts of Natural Capital and Ecosystem Services into operational frameworks.	http://www.openness-project.eu/	
East of England Pilots: ***5 case study areas***: Marston Vale, Blackwater Estuary, Cambridgeshire Fens, Great Yarmouth and Greater Norwich. Provides a place based assessment of ecosystem services across a range of spatial, geographical, social and ecological contexts; how ESA relates to SEA and Sustainability Appraisal; and how ESA can support local decision making.	http://www.sustainabilityeast.org.uk/index.php?option=com_content&view=article&id=60&Itemid=57	
Sustainable River Catchments in the South East ***(SuRCaSE)*** **-** EU project looking to improve the sustainability of water resource management in the South East by integrating practical application of the Ecosystem Approach into catchment-orientated locally-based management plans.	http://www.liv.ac.uk/surcase/	
Polyscape (Bangor University) A 'negotiation tool' for engaging stakeholders in participatory mapping of ecosystem services	http://ekn.defra.gov.uk/wp-content/uploads/2012/12/EKN_Polyscape_sheffield.pdf http://www.slideshare.net/CPWF/polyscape-multiple-criteria-gis-toolbox-for-negotiating-landscape-scale-ecosystem-service-provision	

	http://www.sciencedirect.com/science/article/pii/S0169204612003532	
Welsh Government: - Ecosystem Approach examples	http://www.wales.gov.uk/topics/environmentcountryside/consmanagement/nef/casestudies/?lang=en	
Beckingham Marshes Explores changes in rural land use in floodplains by measuring the range of ecosystem services provided under different management scenarios.	http://www.sciencedirect.com/science/article/pii/S0921800910000480	Posthumus, H., Rouquette, J.R., Morris, J., Gowing, D., Hess, T. (2010). A framework for the assessment of ecosystem goods and services: a case study on lowland floodplains in England. Ecol. Econ. 69, 1510-1523.
Urban Rivers Corridors and Sustainable Living Agendas ***(URSULA)***Developed innovations, tools and knowledge to help guide the regeneration of urban river corridors through social, economic and environmental gains to be made by integrated and innovative interventions	http://www.ursula.ac.uk/	
Group c)	***Website***	***Reference***
West Country Rivers Trust - WATER Interreg Project (***Wetted land: The Assessment, Techniques & Economics of Restoration****)* aims to revolutionise the way we restore and manage our environment by developing innovative funding mechanisms ***The Upstream Thinking project***, funded by South West Water, aims to improve raw water quality through a collaborative approach with landowners assisted in the protection of catchments as part of an integrated approach to land management	http://tamarconsulting.org/wrt/projects/water.htm; (under construction) http://www.projectwater.eu/ http://www.wrt.org.uk/projects.html	West Country Rivers Trust (2012). PES Guide.
Frome and Piddle Wessex Water led initiative with WCRT and others to develop and implement an approach to identify and resolve catchment issues which would benefit from a collaborative approach.	http://www.wessexwater.co.uk/environment/threecol.aspx?id=7525&linkidentifier=id&itemid=7525	
JNCC ***Irish Sea*** Pilot project to test ways of integrating nature conservation into key sectors in order to make an effective contribution to sustainable development on a regional basis	http://jncc.defra.gov.uk/page-1541 http://jncc.defra.gov.uk/pdf/irishseapilot_all.pdf	
Thanet Natura 2000 The Thanet Coast Natura 2000 site was an early example of where stakeholders participated in a deliberately designed and facilitated consensus building process.	http://www.macaulay.ac.uk/PATHconference/outputs/PATH_abstract_2.2.1.pdf	

RESTORE restoring Europe's rivers Partnership for sharing knowledge and best practice on river restoration. Case studies on how well located, planned and designed development can increase ecological quality, reduce flood risk and create social and economic benefits such as improved recreational facilities and public spaces	http://www.restorerivers.eu/	
Tools Applications Benefits and Linkages for Ecosystems ***(TABLES)*** Case studies of different scales, publics and governance regimes and identifies opportunities and challenges. TABLES uses these to identify and prioritise existing tools via the incorporation of ecosystem services thinking; then testing and evaluating in the field, in live decision-and policy-making processes, leading to a final roadmap toolkit.	http://www.bcu.ac.uk/research/-centres-of-excellence/centre-for-environment-and-society/projects/tables	
Tay catchment Opportunity mapping for Woodland creation Innovative GIS mapping exercise to identify locations of maximum synergy in delivering WFD objectives through woodland planting.		Broadmeadow, S., Thomas, H., Shah, N. and Nisbet, T. (2013). Opportunity mapping for woodland creation to improve water quality and reduce flood risk in the Tay catchment – a pilot for Scotland. Forest Research

10 ANNEX 3: TIMETABLE FOR RBMP DELIVERY AND ESA STAGE

RBMP Production	Purpose	Time period	ESA stages
Getting involved in developing RBMP2	Sets out timetable and work programme; Highlights where people can get involved and asks stakeholders for their ideas on engagement	28 August 2012 – 28 February 2013. **Already completed**	Stage (1), and also elements of (2) and (3)
Current Conditions and Challenges for the Future. This combines the RBMP1 stages of Environmental Characterisation; Economic characterisation; and the Significant Water Management Issues	Risk assessment of attainment of objectives of RBMP1; updating and reviewing objectives and POMS; Description of Services a healthy water environment provides; Identifies and consults on SWMI that should be the focus for draft RBMP.	22 December 2013 - 22 June 2014	Stage (2) and (3), but will also need to include stage (1)
Consultation on changes to heavily modified water bodies (HWMB)	Proposals to designate new, or change existing HMWBs	22 December 2013 – 22 June 2014	Stage (3) and elements of stage (4)
Strategic Environmental Assessment (SEA) scoping report	Determines scope and detail of SEA for RBMP and proposals for consultation	22 December 2013 – 22 June 2014	Stage (2)
Draft RBMP2	Reports on implementation of RBMP1; Consultation on revised environmental objectives and updates to POMs	22 December 2013 – 22 June 2014	Stage (3) and (4)
SEA Environmental report	Sets out potential environmental effects of RBMP2, mitigation and alternatives	22 December 2014 – 22 June 2015	Stage (5)
Habitat Regulations appraisal	Determines impact on protected sites, including appropriate assessments	Completed before 22 December 2015	Stage (2), (3) and (4)
Publish RBMP2	Sets out objectives and implementation strategy 2015 - 2021	Published on 22 December 2015	Stage (5)

11 ANNEX 4: SEPA'S LIST OF ECOSYSTEM SERVICES FROM THE WATER ENVIRONMENT

SEPA have undertaken work internally to identify relevant Ecosystem Services to provide a national overview for use in economic characterisation. These set out Provisioning, Regulating and Cultural services of direct relevance to the water environment, omitting Supporting services to avoid double counting:

Provisioning:

- Abstraction for hydro power
- Abstraction for industry (focussed on Whisky to date)
- Abstraction for agriculture
- Drinking water provision
- Commercial fishing (marine and in the context of RBMP estuarine/coastal)
- Aquaculture

Regulating-

- Land drainage (possible)
- Pollution dilution and detoxification – public sewage
- Pollution dilution and detoxification – diffuse pollution
- Regulation of water flow (i.e. natural flood management)
- Carbon storage in wetland soils

Cultural-

- Habitat provision
- Recreation on/in water (incl. white water rafting, swimming, diving, etc.)
- Riparian recreation
- Beach recreation
- Landscape character
- Recreational fishing
- Cultural heritage
- Cultural/spiritual experience
- Education

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